DOCUMENT RESUME

ED 365 177 HE 026 857

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TITLE	A Study of Underprepared Students at One Community College: Assessing the Impact of Student and Institutional Input, Environmental, and Output Variables on Student Success. ASHE Annual Meeting Paper.
PUB DATE	4 Nov 93
NOTE	15p.; Paper presented at the Annual Meeting of the Association for the Study of Higher Education (18th, Pittsburgh, PA, November 4-10, 1993).
PUB TYPE	Speeches/Conference Papers (150) -- Reports - Research/Technical (143)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	*Academic Achievement; *Academic Persistence; College Environment; College Freshmen; *College Outcomes Assessment; Community Colleges; Comparative Analysis; Grade Point Average; *High Risk Students; Reading Skills; Statistical Analysis; *Student Evaluation; Student Placement; Two Year Colleges; Two Year College Students; Undergraduate Study
IDENTIFIERS	*ASHE Annual Meeting; *Johnson County Community College KS

ABSTRACT

This study identified input, environmental, and output variables accounting for differences between successful and unsuccessful groups of underprepared students at Johnson County Community College (Kansas). The study applied an adaptation of Alexander Astin's input-environment-output model of assessing student and institutional effectiveness. "Underprepared" students (n=313) were defined as earning assessment scores resulting in placement in a developmental reading or English course. Successful students (n=188) were defined as those underprepared students who eventually earned a degree or certificate or completed at least 24 credit hours. Two input variables were found to distinguish between the successful and unsuccessful groups: (1) reading scores and reading placement level on the "Assessment of Student Skills for Entry and Transfer" measure and (2) high school grade point average. The only environmental variable separating the groups was the number of first term credit hours. Two output variables, highest developmental English course completed and nondevelopmental grade point average, were also significant factors in separating the two groups. Based on these findings, the completion of reading and English developmental courses appeared of utmost importance in improving the underprepared student's chances for success. Institutional policies that "force" intervention were also viewed as important. Finally, mandatory placement in developmental courses during the first semester of enrollment seemed vital to helping underprepared students succeed. (Contains 20 references.) (GLR)

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This paper was presented at the annual meeting of the Association for the Study of Higher Education held at the Pittsburgh Hilton and Towers, Pittsburgh, Pennsylvania, November 4-7, 1993. This paper was reviewed by ASHE and was judged to be of high quality and of interest to others concerned with the research of higher education. It has therefore been selected to be included in the ERIC collection of ASHE conference papers.

A Study of Underprepared Students At One Community College: Assessing the Impact of Student and Institutional Input, Environmental, and Output Variables on Student Success

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The purpose of this research was to determine whether successful and unsuccessful underprepared community college student groups were significantly different, and further to determine if specific input, environmental, and output variables were identifiable as contributors to success.

Introduction

Community colleges, well known for their open-door policies, have been the leaders in providing access for academically underprepared students (Eaton, 1992; Richardson, Fisk & Okun, 1983; Roueche, 1984). As the number of underprepared students entering community colleges continues to increase each year, budget constraints are forcing institutions to streamline all services including those designed specifically for underprepared students (Cohen & Brawer, 1989; Cross, 1981; Moore & Carpenter, 1985; Parnell, 1990). Since limited research has been conducted to date concerning how to most effectively serve the underprepared population, determination of which programs and services should be eliminated, retained or enhanced is difficult. Further, little has been written or researched in relation to identifying specific student attributes and institutional factors or combinations of factors that contribute most to successful outcomes for underprepared students. The purpose of this study was to apply an adaptation of Alexander Astin's (1974, 1985, 1991) input-environmental-output model of assessing student and institutional effectiveness to a cohort of institutionally defined community college "underprepared students" and to determine if selected input, environmental, and output variables contribute to students' successful outcomes.

Methodology

The sample for this study was drawn from the population of students who completed the entry-level assessment at Johnson County Community College (JCCC) during the 1988-89 school year. With a Fall 1992 enrollment of 15,492 students, JCCC is located in the southwest corner of the Kansas City metropolitan area. JCCC is a public, two-year, comprehensive community college serving students who plan to transfer to a four-year institution, earn a degree to enter the work force, or improve skills for personal or job-related reasons. In the Fall 1988 semester, the enrollment was 11,164, and new students were required to complete the ASSET Basic Skills inventory prior to enrollment. The ASSET Basic Skills inventory was designed specifically for community colleges by the American College Testing (ACT) in 1982, and by 1993 was used for entry level assessment by the majority of Kansas community colleges (Matson, 1993). Placement in

developmental or nondevelopmental reading, English, and mathematics classes was based on the assessment scores of students. Those scoring below a certain level on the reading assessment were required to enroll in one of two developmental reading classes (LC 125 Fundamentals of Reading or LC 126 Reading Skills Improvement) during their first semester at the institution. Students scoring at a developmental English level could choose the timing of their initial enrollment in the appropriate developmental class, either ENGL 102 Writing Strategies or ENGL 106 Introduction to Writing. Institutionally, students earning assessment scores that resulted in placement in a developmental reading or English course were identified as "underprepared."

For this study, underprepared students indicating an entry-level goal of earning a degree/certificate or transferring to a four-year institution were included in the research sample. In Fall 1992, the academic records of the students in the 1988-89 cohort were reviewed. Students were considered "successful" if they had met one of two criteria: 1) completed at least 24 credit hours, the equivalent of two semesters of full-time coursework, or 2) earned a degree or certificate. In the final sample, 313 subjects were included, with 188 in the successful group and 125 in the unsuccessful group.

Two research hypotheses were analyzed as part of this study:

> Hypothesis 1: The input, environmental, and output variables within the successful group and the unsuccessful group are correlated.
>
> Hypothesis 2: The successful group of students will be significantly different from the unsuccessful group on the input, environmental, and output variables.

In addition, two research questions were investigated:

> Research Question 1: How much of the difference between the successful group and the unsuccessful group was explainable?
>
> Research Question 2: Which input, environmental, and output variables contributed to the variance, and thus the success of the underprepared students?

A one-way multivariate analysis of variance (MANOVA) with a follow-up discriminant analysis was used to test the hypotheses and to provide information related to the research questions.

Summary of Findings

Simple Descriptive Statistics

In comparing the successful group to the unsuccessful group on input variables, students in the successful group, on average, entered the college at 19 years of age, had a 2.42 high school grade point average, and had been out of school less than one year. In addition, students in the successful group had an ASSET Reading score that placed them in LC 127 College Reading Skills, the highest level developmental reading course offered at the institution, and an ASSET English score that placed them in ENGL 106 Introduction to Writing, the highest level developmental English course available. Students in the unsuccessful group were only slightly older at 19.2 years of age and had a lower mean high school grade point average of 2.22. The ASSET scores and placement levels for reading and English of the unsuccessful students were virtually the same as those of the successful students. Table 1 below provides a summary of the sample descriptive statistics.

Input Variable	Successful Cell Mean	Unsuccessful Cell Mean	Ranges and Codes
Age	18.98	19.20	Years of age
H.S. GPA	2.42	2.22	Range: 0 - 4.000
Years out of School	.500	.624	Number of years since last educational experience. (0 = student came directly to college after high school graduation)
ASSET Reading Score	22.89	22.54	Raw Score Range: 0 - 37
Reading Placement Level	2.71	2.64	1 - 4 Levels 1 = LC 125 Fund. of Reading (Required Placement) 2 = LC 126 Read. Skills Improvement (Required Placement) 3 = LC 127 College Reading Skills (Recommended Placement) 4 = No Placement Recommended
ASSET Engl. Score	19.44	19.00	Raw Score Range: 0 - 25
English Placement Level	1.95	1.98	1 - 3 Levels 1 = ENGL 102 Writing Strategies (Developmental Course) 2 = ENGL 106 Introduction to Writing (Developmental Course) 3 = ENGL 121 Composition I (Non-developmental Course)

Table 1: Cell Means - Input Variables

In terms of the environmental profile, students in the successful group, on average, enrolled in their first developmental class during their first or second semester (1.43 semesters) at JCCC. They received no financial aid, enrolled in 11.6 credit hours during the first term, and worked 16-20 hours each week. Students in the unsuccessful group took fewer hours (10.6) during their first semester at JCCC. In addition, the unsuccessful students were more likely to take their first developmental class during their second semester of enrollment at the college (1.71 semesters) as compared to the initial semester of developmental class enrollment by successful students.

Environmental Variable	Successful Cell Mean	Unsuccessful Cell Mean	Ranges and Codes
Developmental Enrollment Semester	1.43	1.71	Range = 0 - 10 semesters (0 = student never enrolled in a developmental course)
Financial Aid	1.23	1.22	1 = No Financial Aid Received 2 = Financial Aid Received
Credits First Term	11.60	10.61	Range: 0 - 19 credit hours
Hour Worked Per Week	3.94	4.10	Range 1 - 6 1 = no hours worked 2 = 1 - 10 hours worked 3 = 11 - 15 hours worked 4 = 16 - 20 hours worked 5 = 21 - 30 hours worked 6 = 31 > hours worked

Table 2: Cell Means - Environmental Variables

The output profile showed the largest mean differences between the successful and unsuccessful groups. In the successful group, students had a higher mean developmental college grade point average (2.284) than students in the unsuccessful group (1.595). On average, students in the successful group had a higher nondevelopmental college g.p.a.(2.134) than unsuccessful students (1.522). The highest developmental reading course completed by both groups was LC 127 College Reading Skills, the highest developmental reading course offered by the institution. On average, the highest developmental English class completed by the successful group was ENGL 106 Introduction to Writing, the highest level developmental English course offered by the student; however, the highest developmental English class completed by the unsuccessful group was the lowest level developmental English class, ENGL 102 Writing Strategies. Table 3 on the following page provides a summary of the means for each of the output variables.

Output Variable	Successful Cell Mean	Unsuccessful Cell Mean	Ranges and Codes
Developmental GPA	2.284	1.595	Range: 0.000 - 4.000
Nondevelop. GPA	2.134	1.522	Range: 0.000 - 4.000
Highest Developmental Reading Course Completed	3.05	2.81	Range: 0 - 4 0 = no course taken 1 = LC 125 2 = LC 126 3 = LC 127 4 = None required
Highest Developmental English Course Completed	1.70	1.12	Range 0 - 3 0 = no course taken 1 = ENGL 102 2 = ENGL 106 3 = No developmental course required

Table 3: Cell Means - Output Variables

Research hypotheses

Hypothesis 1: The first hypothesis was investigated using Barlett's test of sphericity. The test yielded a significance value of (χ^2 = 1544.04830, df = 91, $p \leq 0.0005$), thus indicating that the dependent input, environmental, and output variables were correlated and that continuation with the MANOVA test was appropriate.

Hypothesis 2. The second research hypothesis was to test whether the successful group of students was significantly different from the unsuccessful group on the input, environmental, and output variables.

The results of two multivariate tests of significance, the Hotelling's T^2 test and the Wilks test, were used to test this hypothesis and make follow-up interpretations. The Hotelling's T^2 statistic was used to consider all variables together and simultaneously test the hypothesis that several population means do not differ from a specified set of constants (Norusis, 1992, p. 67).

The results of the Hotelling's T^2 test indicated that the F statistic was significant (T^2 = .225, DF(14, 298) = 4.790, $p < .0005$), and that the statistical hypothesis (the two group population means were the same) was rejected. Given that the groups displayed significant difference, two follow-up research questions were investigated.

Research Question 1. How much of the difference between the successful group and unsuccessful group on the input, environmental, and output variables was explainable?

The Wilks' lambda statistic (λ = .816) was used to answer this question. According to Norusis (1992), the Wilks' lambda was the measure of the proportion of total variability not explained by group differences (p. 76). Therefore, for this study, a significant 18.4% of the difference between the successful and unsuccessful groups on the input, environmental, and output variables was explainable.

Research Question 2. Which input, environmental, and output variables contributed most to the variance, and thus, the success of the underprepared students? A follow-up discriminant analysis procedure was performed to investigate this research question and to determine the best linear combination of input, environmental, and output variables that distinguished the successful group from the unsuccessful group (Norusis, 1992, p. 75). The univariate *F*-tests, the standardized discriminant function coefficients, and the correlations between dependent and canonical variables (structure coefficients) were used in the interpretation of the discriminant analysis.

Variable	Univariate *F*- Tests	Standardized Discriminant Function Coefficients	Structure Coefficients *r*	r^2
Input variables				
High School GPA	.001	-.192	-.402	.162
Years Out of School	.509	.066	.079	.006
ASSET Reading Score	.633	.500	-.057	.003
Reading Placement Lev.	.460	-.445	-.089	.008
ASSET English Score	.376	-.136	-.106	.011
English Placement Level	.283	.273	.129	.017
Environmental variables				
Dev. Enrollment Term	.138	.038	.178	.032
Financial Aid	.922	.081	-.012	.0001
Credits First Term	.019	-.311	-.281	.079
Hrs. Worked Per Week	.324	-.029	.118	.014
Output variables				
Developmental GPA	.000	-.150	-.646	.417
Nondevelopmental GPA	.000	-.411	-.665	.442
Highest Devel. Reading	.143	-.013	-.176	.031
Highest Devel. English	.000	-.537	-.736	.542

Table 4: Discriminant Coefficients and Correlations

The univariate *F*-tests were reviewed; however, final interpretation did not rest on these results since no controls were included for Type I error. Results of the univariate *F*-tests revealed significance for high school grade point average (p = 0.001), credit hours

first term ($p = 0.019$), developmental grade point average ($p < 0.0005$), nondevelopmental grade point average ($p < 0.0005$), and highest developmental English course completed ($p < 0.0005$).

The standardized discriminant function coefficients were used to find non-redundant variables that had a significant effect in separating the two groups. Two input variables were found to be significant in discriminating between the successful and unsuccessful groups: ASSET reading score ($\beta = .500$) and reading placement level ($\beta = -.445$). One environmental variable, credit hours first term ($\beta = -.311$), contributed significantly to the separation of the successful group from the unsuccessful group. Finally, two output variables were important in discriminating between the two groups: highest developmental English course ($\beta = -.537$) and nondevelopmental grade point average ($\beta = -.411$).

The correlations between dependent and canonical variables (structure coefficients) were used to determine how much each of the original dependent variables correlated with the discriminant function or the discriminant scores. Examination of the results of the canonical discriminant analysis indicated that the following variables were most closely associated with the discriminant scores:

Input variable: high school grade point average ($r = -0.402$)
Environmental variable: credits first term ($r = -0.281$)
Output variables: developmental grade point average ($r = -0.646$)
nondevelopmental grade point average ($r = -0.665$)
highest developmental English courses ($r = -0.736$)

The disparity between the small discriminant function for high school grade point average and its large structure coefficient was indicative of the strong correlation exhibited between high school grade point average and both developmental and nondevelopmental grade point average. The actual magnitude of the relationships between high school grade point average and the structure coefficient was not reflected in the discriminant function coefficient due to effects of multicollinearity and order of entry (Neuliep and Hazleton, 1986, p. 219).

Further interpretation indicated that 54% ($r^2 = 0.542$) of the variance of the highest developmental English course completed variable was accounted for by the discriminant function; 44% ($r^2 = 0.442$) of the variance of the nondevelopmental grade point average was accounted for by the discriminant function; and 42% ($r^2 = 0.417$) of the variance of the developmental grade point average was accounted for by the discriminant function. Given the information outlined above, it was concluded that research hypothesis 2 was not rejected, and further that the variables contributing most to the variance between the two groups had been identified.

Conclusions and Institutional Implications

Two input variables were identified as having an impact on the successful outcome of underprepared students. First, the standardized discriminant function coefficient for both ASSET reading score (β = .500) and the subsequent reading placement level (β = -.445) proved to be significant in separating the successful student group from the unsuccessful student group. However, these variables did not display high correlation with the discriminant functions as indicated by the values of the structure coefficients for each of these variables: ASSET reading score (r = -.057) and reading placement level (r = -.089). It was obvious that the reading score and placement level contributed to the separation of the groups, and one would expect that without any type of intervention, students with lower reading scores would naturally tend to cluster in the unsuccessful group while students with higher reading scores would tend toward clustering in the successful group. However, this outcome was not allowed to follow a natural course, as institutional policy forced intervention that affected the outcome.

Students who scored at a developmental reading placement level were required, depending on their assessment score, to complete either LC 125 Fundamentals of Reading or LC 126 Reading Skills Improvement during their first semester of enrollment. A very strong relationship was shown between reading placement level and highest developmental reading course completed (r = .827) indicating that most students successfully completed the reading course into which they were placed. Through this forced placement, enrollment, and subsequent completion of developmental reading classes, students with lower reading scores did not cluster in the unsuccessful group, and therefore, a high correlation between the reading placement level and the discriminant score did not occur. This finding reinforces the institution's decision to mandate both reading assessment and placement. In addition, the policy of requiring successful completion of the reading course prior to continued enrollment appears to be warranted and important for the overall academic success of the student. JCCC appears to be a leader in the state of Kansas with this type of policy. Of the five largest community colleges in Kansas, all using the ASSET instrument, JCCC is the only institution enforcing a policy of mandatory placement in a developmental reading class during the first semester of enrollment (Personal Communication, 1993).

A second input variable, high school grade point average, appeared to make a significant contribution in the successful outcome of students (r = -.402). Thus, students with higher grade point averages tended to cluster toward the successful group. The mean high school g.p.a. of the unsuccessful group was 2.22 while the mean of the successful group was 2.416. Although not an entirely unexpected finding, at JCCC, the high school grade point average is not used for any type of prescreening or placement. However, based on the results of this study, it would seem incumbent on the institution to consider using this indicator of past performance as one additional piece of data in advising and counseling underprepared students. As open door institutions, community colleges will continue to accept students with lower high school grade point averages; therefore, special attention should be directed toward students with high school grade point averages below

2.00. Mandatory, intrusive and earlier advisement and prescription may be important considerations for these students. JCCC, like most community colleges, does not currently have a policy of mandatory advisement; however, the institution is currently investigating steps to move toward such a policy for specific groups. A pilot study conducted during the Fall 1992 semester suggested that contact with a counselor was an important factor in student success. The group of underprepared students who were required to meet with a counselor one or more times earned significantly higher g.p.a.'s (2.00 compared to 1.62) and earned significantly more hours (8.01 compared to 5.26) than underprepared students who did not meet with a counselor (Castator, Franklin, Soltz, & VanLandingham, 1993). Early intervention with underprepared students based on high school grade point average is warranted, and this information should be shared with local high school personnel. Students with g.p.a.'s below 2.00, who have indicated a desire to attend the community college, need to be identified at the high school level during their junior or senior year. With early identification, pre-advisement and contact with a community college counselor could begin even before the student reaches the institution, thus enhancing the student's chances for success.

The only environmental variable having any effect on separating successful students from unsuccessful students was credit hours first term. The effect was slight but worth noting. Sixty-nine percent of the students in the successful group were enrolled as full-time students (12 or more credit hours) during their first semester on campus, while 56% of students in the unsuccessful group were enrolled as part-time students. On average, students in the successful group were enrolled in 11.6 hours during the first semester of enrollment compared to 10.6 hours for the unsuccessful group. Although the difference was slight, this finding may suggest that students who are on campus more will be more likely to take advantage of the institutional support systems outside the classroom, and in doing so, obtain the help and assistance needed to succeed at the community college. This proposition has been supported by other authors who suggest that involvement at four year institutions is important for student retention and success (Astin, 1993; Noel, 1985; Pascarella and Terenzini, 1991); however, the same type of information has not been available for community college students. Further study on the type and extent of activities and support services the students in this sample participated in while enrolled at the institution seems in order to determine if the students taking more credit hours used support services more readily, and as a follow-up to determine if students who became more involved in the institutional environment were more successful.

Three output variables had significant impact on both separating the successful student and on contributing to the success of students in this sample. The developmental grade point average (r = -.646) and nondevelopmental grade point average (r = -.665) showed almost identical correlation with the discriminant function. Since JCCC students must have a cumulative grade point average of 2.00 to earn a degree or certificate, the researcher had anticipated that the grade point average would be a contributor to success for this sample. Findings of the study confirmed this, and added further information regarding institutional grading practices and student outcomes.

On average, students in the successful group had a developmental g.p.a. (2.284) significantly higher than students in the unsuccessful group (1.595). This indicates that successful completion of developmental courses is important to a student's persistence and attainment of educational goals. Considering the results of the 1992 pilot study conducted at JCCC regarding required advisement (Castator, Franklin, Soltz, VanLandingham, 1993), the researcher would propose that the difference in grade point averages may have been a result of interaction with a counselor. Further investigation of this supposition is warranted. Couple the finding that successful completion of developmental courses is significant with the previous notion that early completion of a required reading course is important, and a consistent pattern of early successful completion of required developmental courses at the community college seems to be increasing.

Since the students in this study were intending to earn a degree/certificate or transfer to a four-year institution, successful completion of nondevelopmental courses was also imperative for success. A relatively strong relationship was seen between developmental and nondevelopmental grade point average (r = .472), indicating that high developmental g.p.a.'s were associated with high nondevelopmental g.p.a.'s. On average, the nondevelopmental g.p.a. for students in the successful group (2.134) was only 0.15 points below the developmental g.p.a.. (2.284). An even smaller difference of 0.073 was found for the unsuccessful group (developmental g.p.a. = 1.595, nondevelopmental g.p.a. = 1.522). These factors indicate that grading criteria were consistently applied across developmental and nondevelopmental courses, and that successful underprepared students were able to easily make the transition from developmental to nondevelopmental classes.

Of all the variables considered, the one revealing the highest correlation with the discriminant function or, in other words, contributing the most to success, was the highest developmental English course completed (r = -.736). Based on their English assessment scores, students were placed into one of three English courses: ENGL 102 Writing Strategies, ENGL 106 Introduction to Writing, or ENGL 121 Composition I. Both Writing Strategies and Introduction to Writing were developmental courses, and unlike a reading course that had to be taken during the first semester of enrollment, these classes could be taken at any time during a student's tenure at JCCC. On average, ENGL 106 Introduction to Writing was the highest level developmental English class completed by the successful students, while students in the unsuccessful group completed only ENGL 102 Writing Strategies. More specifically, 84% of the students in the successful group completed Introduction to Writing while only 13% completed no developmental English class. In the unsuccessful group, 42% completed no developmental English class while only 54% completed Introduction to Writing. It must be noted that, on average, the English placement level for students in both groups was Introduction to Writing; thus, the groups were quite similar on entry level in regard to English composition mastery. Unlike the relationship between reading placement level and highest developmental reading course completed (r = .827), the relationship between English placement and highest developmental English course completed was very weak (r = .096). Also, unlike reading, there was no forced intervention on the part of the institution to ensure successful completion of the developmental English course prior to enrollment in other classes.

This finding has the most far-reaching impact on the institution as well as on the body of information related to community college underprepared students in general. Like many other community colleges, JCCC has no policy requiring successful completion of a developmental English course prior to enrollment in other classes (Matson, 1993; Personal Communication, 1993). Very little has been written or amassed regarding the assessment and placement policies of community colleges across the country. If successful completion of the highest level developmental English course has the largest impact on the success of underprepared students, then steps should be taken by the institution to ensure that students enroll in the developmental English courses early in their tenure at the community college. Implementation of a policy and procedures that require students assessed at a developmental English level to enroll in the appropriate English class during their first semester at the college is warranted to increase the likelihood of overall student success.

An extension of this idea is to initiate a "developmental semester" for students scoring at developmental levels in English, reading, and/or mathematics, since other research suggests that completion of both English and mathematics developmental courses significantly enhances the student's chance for success (Bishop, 1992, p. 1). A "developmental semester" would include a combination of developmental reading, writing, and mathematics classes, and students with like abilities would be scheduled into two or more of these classes. The combination of forced and repeated student interaction as well as concentrated skills improvement could further improve an underprepared student's success ratio (Tinto, 1987).

In summary, based on the results of this study, the completion of reading and English developmental courses is of utmost importance in improving the underprepared student's chances for success. Institutional policies that "force" intervention are needed. Mandatory placement in developmental courses during the first semester of enrollment seems vital as a key to helping underprepared students succeed in meeting their educational goals.

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